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COMPARATIVE ANALYSIS OF G+5 BUILDING WITH DOG LEGGED AND OPEN WELL STAIR CASES BY USING ETABS SOFTWARE

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ABSTRACT
A system of steps called stairs allows one to get from one level to another. An essential functional component of a structure is a staircase. Stairs are becoming more and more popular right now due to their appealing look. A flight of steps that rises to a half step before turning 180 degrees and continuing upward is known as a dog-legged staircase, and it is one of the most basic types of stairs. Due to its sectional elevation look, it is also known as the Dog Legged Staircase. An open well is comparable to a dog-leg stair, with the exception that it separates the two steps. Public buildings often employ the open newel stair, which is a practical stair style.

In this work, response spectrum analysis is used to analyse a G+5 model building. The outcomes, which include tale bending, story shear, story drift, and building In zone V seismic conditions, ETABS software is used to compare the torsion, model frequency, and model stiffness of dog-legged and open well stair cases.

I. INTRODUCTION

1.1 General

A set of stairs that provide access from one level to another is called a staircase. One important functional element of a structure is the staircase. Stairs are gradually becoming more well-known due to their attractive look. However, the stair's design and inspection are problematic. The existing methods of study rely on several glorifications and assumptions because of the intricate mathematical design of this system. The restricted component method has been employed to examine the validity of the existing tactics under this basis. In order to develop a streamlined design measure, the evaluation has been extended further to determine the pressure results of the stair section, including a midway arrival. The main feature of every home or commercial structure is the staircase.

Steps in a staircase are constructed either to rise continuously from one level to the next or to ascend to an arrival between floors, with a series of steps increasing higher from the arrival to the floor above. Even yet, there are many different types of steps that may be built and constructed using steel, timber, or solid materials. Certain heaps, similar to those used for floor design, should be conveyed by its design. The design is often based on the guidelines provided in different work codes, without taking into account special considerations for varying stair section states and support situations. Interestingly, due to its inherent mathematical nature, the behaviour of the helical stair section has not been conclusively determined. Only a few scientists' efforts can ensure a drastic change in behaviour due to changing circumstances and the absence of information provided by norms of practice to assist designers in differentiating between different types of stair sections. Thorough hypothetical research using a variety of assistance strategies and trial testing conducted on real or model stairs may be used to build up the actual behaviour of the stair section. A building's stairs are an important functional element.

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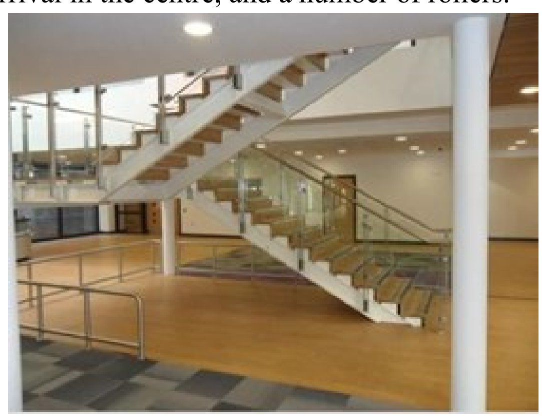
Because of their seductive appeal, stairs are now becoming more and more common. Whatever the case, the stair's design and inspection are quite problematic. The existing methods of study rely on several glorifications and assumptions because of the intricate mathematical design of this system. The restricted component approach has been utilised to evaluate the validity of the present methods within this foundation. In order to develop a streamlined design measure, the evaluation has been extended to determine the pressure results of the stair chunk, including a middle-of-the-road arrival.

Given its practical importance, a staircase is an essential component of a building and an auxiliary arrangement of the structures. When compared to modern elevators, staircases are not only more effective in emergency situations (such as fire escapes, calamitous events, etc.), but they also significantly strengthen the structure. It is developed separately for seismic and non-seismic powers because to the intricate staircase demonstration. One way to describe the effect of staircases on the RC outline structure described in writing is that they allow for intermittent displays, a range of disappointed united underlying components, a commitment to non-straight building execution, and adjustments to various seismic boundaries, such as a reduction in the building's time-frame and story float. Therefore, it is generally assumed that staircases have a significant influence on the analysis and design of RC outline structures. Additionally, stone work is frequently used in DFDF REDWS fills to compensate for gaps between the vertical and even opposing components (as segment mass) of the building outlines. This is done with the assumption that the fills won't help to oppose any kind of horizontal or pivotal burden. As a result, its significance in analysing edge is often overlooked. Ongoing studies have shown that, in terms of solidity, strength, and energy dispersion, a well constructed in-filled case may outperform an uncovered one. The composite activity between infill boards and casings, according to the underlying viewpoint, provides greater horizontal opposition and in-plane firmness, which reduces aggregation and entomb story float.

Dog-Legged Staircase

The dog-leg staircase, which rises to a half advance before turning 180 degrees and moving onwards, is perhaps the easiest kind of steps. Because of its look in sectional height, it is also known as the Dog Legged Staircase. It is a very common and well-known kind of staircase that is used in both private buildings and throughout the day. It consists of two inversely orientated flights, separated by a quarter in space or an arrival in the centre, and a number of rollers.



Dog legged stair

Open well stair case

Aside from the fact that the two levels are separated in this case by an open well, it resembles a dog-legged staircase. One useful kind of stair that is often used in open structures is the open newel stair. The open well's width varies from 60 to 120 cm, depending on the available area. As seen in Fig., the two flights were either separated by a half space loaning or two quarter space arrivals with a number of steps. A 'Lift' may be fixed using the open well between the two flights.

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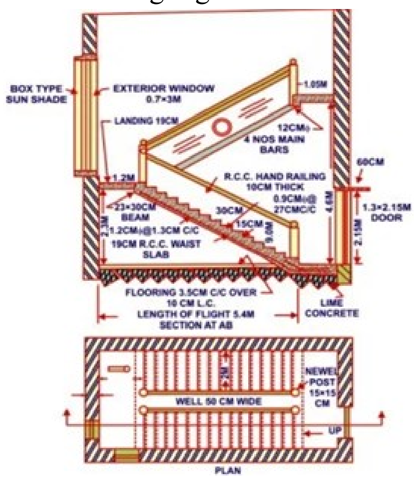
The well or gap that exists in the centre of the stairway's balustrades is what gives the open well staircase its name. It may have two or more stairwells. In situations when a level is covered by two flights (referred to as a U-molded stair at that time). The hole between the balustrades is the primary distinction between the open well staircase and the dog-leg staircase.



Open well stairs

ETABS Software

A comprehensive integrated programming bundle for the fundamental research and design of buildings is the innovative and forward-thinking new ETABS. This latest ETABS combines 40 years of continuous innovation to provide unparalleled 3D object-based demonstration and perception tools, lightning-fast linear and nonlinear scientific power, sophisticated and comprehensive design capabilities for a variety of materials, and skilfully realistic displays, reports, and schematic drawings that enable customers to quickly and efficiently translate and obtain research and design outcomes.

ETABS manages all aspect of the design process, from the inception of the concept to the production of schematic drawings. Model production has never been easier thanks to natural drawing commands that take into account the rapidly evolving floor and height outlines. Computer-aided design drawings may be used as formats that can be layered with ETABS articles or converted directly into ETABS models. The best-in-class SAP Fire 64-bit solver supports nonlinear demonstration techniques, such as development sequencing and temporal effects (e.g., creep and shrinkage), and enables the rapid dissection of extremely large and complicated models.

Similar to the limit check for steel associations and foundation plates, the design of steel and solid casings (with computerised streamlining), composite pillars, composite segments, steel joists and cement and brick work shear dividers is integrated. Models may be supplied in a reasonable amount of time, and the structure may clearly display all of the outcomes. For every inquiry and design outcomes, comprehensive and flexible reports are available, and schematic development drawings of defining plans, schedules, nuances, and cross-segments may be created for steel and cement buildings.

Whether they are working with one-story mechanical structures or the largest corporate elevated structures, ETABS provides an unparalleled suite of tools for underpinning professionals developing buildings. Since its introduction many years ago, ETABS has been known for being massively fit yet easy to use. This latest supply continues that tradition by providing professionals with the mechanically advanced but intuitive programming they need to be their usually profitable.

- Structural system modelling;
- Loading, analysis, and design;
- Output, versatility, and interoperability

Objectives of the study

The project's primary goals are as follows:

1. To use IS 1893:2002 to investigate a building's seismic behaviour
2. To examine the building models with open well staircases and dog legs.

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3. To compare the outcomes of open well and dog-legged stairs for story drift, shear force, bending moment, and building torsion.
4. To examine the response spectrum analysis of the multistory structures in ETABS V9.7.4.

Summary

A set of stairs that provide access from one level to another is called a staircase. One important and practical part of a structure is a staircase. Steps in a staircase are constructed either to rise continuously from one level to the next or to ascend to an arrival between floors, with a series of steps increasing higher from the arrival to the floor above. Stairs are now becoming more well-known due to their attractive look. Because of its practical importance, a staircase is one of the fundamental components of a building and an auxiliary arrangement of the buildings. The dog-legged staircase, which has a stairway that rises to a half advance before turning 180 degrees and moving onwards, is perhaps the simplest kind of steps. In addition to being similar to a dog-legged stair, an open well separates the two steps in this scenario. One useful kind of stair that is often used in open structures is the open newel stair. The open well's width varies between 60 and 120 cm, depending on the available area.

II. LITERATURE REVIEW

A. Masood4, A. Baqi5, M. Danish2, M. Shariq3, Zaid M1, et al. (2013)

By obtaining various building models—an uncovered edge, an edge with infill boards, and a casing with infill except for the first story—with and without staircases, as well as varying the number of stories of the building from four to ten, the impact of staircases on RC outline structures has been examined in the current study. With the aid of FEM-based programming, the models' linear response spectrum analysis has been finished in accordance with Seems to be: 1893 (Part 1) - 2002 and IS: 456 - 2000. The seismic characteristics of models without a staircase have been compared to those of models with time period, mass participation factor, and story drift. Additionally, the influence of the building's altering staircase arrangement has also been seen. Despite these, the effects of short segments, variations in photos of bars and sections attached to staircase pieces, dissatisfaction and deformity in staircase models, and the link between the effects of infill boards have also been considered.

This analysis led to the conclusion that the mass and sidelong solidity of the structure form determine its characteristic period of vibration. The addition of a staircase and infill boards increases the building's bulk and hardness, although the latter is more important. When in-fills and staircases are taken into account, central time durations, as measured by the experimental articulation provided in IS: 1893 (Part 1): 2002, have been shown to be decreasing. When the influence of the stairs is taken into consideration, it has been seen that the tale floats are significantly reduced. It is found that every float is within the acceptable breaking threshold.

Abdul Baqi2, S.M. Talha, Zaid Mohammad1, et al. (2015)

Since stair components have a low bendable limit and may be subject to brittle disappointment, stairs are a vulnerable part of structures that are susceptible to earthquakes. Furthermore, the essence of an RC building is not taken into account while disassembling it for seismic and gravity loads because to its complexity; instead, its weight is transferred to supporting dividers or pillars. In this sense, the design of stairs is clearly fascinating. Stair components are often supported on dividers or cast solid with the floor bar provided along or across the flight path. These backings provide

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hoarding minutes at corners and near supports, as well as unbending nature in the stair chunks. Similarly, the piles are shifted from the stair piece to the supporting bars as part of the building shape, which significantly reduces the divergence and minutes in the stair chunks. Additionally, when stair chunks are subjected to seismic loads, their behaviour changes. Currently, research on the behaviour of reinforced solid stair sections takes into account several courses of action with and without seismic impacts. Minute estimates are considered to be obtained in standard design techniques based on the establishment of standard codes of practice.

It was assumed from this experiment that the largest bowing second and its area in the stair chunk do alter when landing on their sides on separators or the outline of a light-emitting skyscraper. As previously seen, in Model 2, side backings are provided upon delivery, but in Model 1, the stair piece is supported on the outrageous landing edges. By providing side backings at the floor landing, the maximum hanging minutes along the way, such as Mx, at mid-range are reduced to only 16 percent. The area of crimps exhibits the hoarding second up to a maximum estimate of 10.95 k-Nm. This demonstrates that the influence of side backings at floor arrivals and the coherence of content in the bordering arrivals lead the minutes to be reallocated on a surface level.

In 2018, Sumit Gupta1, Sumit Pahwa2, et al.

Our primary goal is to finish the stair format in order to ensure that the shape is safe and generally useful in the face of all potential stacking situations and to meet the needs of the component for which it was created. All security requirements should be met by the structure in order to justify the hold cost. The shape's regular point-by-point arrangement is the result of some research using city organisers, speculators, customers, modellers, and other designers. All of the challenging situations that the key designers had to deal with were acknowledged as opportunities to develop programming projects that were easily used, including STAAD-PRO, ETABS and SAFE, SAP, and so on. The main business programming software for underpinning assessment in the globe is STAAD-master. For both regular and irregular arrangement setups, the design outcomes of a stair case using STAAD PRO are used. The most common kind of developments in Indian cities are reinforced concrete (RC) building outlines.

The dynamic influence on the stair with dead load and live burden situations was assumed to have been examined in part by this experiment. Horizontal power, base shear, story float, and story shear are the essential boundaries used for the study, and the findings are interpreted based on these boundaries.

Chen BIAN2, Chun-Yi XU3, Zhi-Wei CAO1, et al. (2014)

Two PC models of a solid casing with a staircase were created, and by using the base shear strategy and range analysis by ETABS, the seismic execution of the models in a flexible stage was established. The results demonstrate that adding a staircase to models will fundamentally alter how edge structure is shown seismically. According to the article, the seismic design of solid casing with a staircase should start with the PC model with a staircase and the response range analysis.

It was assumed from this study that stairs have a key addition to the fundamental sidelong solidness. The essential horizontal firmness grows substantially towards the route along the stepping stool, which is choreographed, with parallel bends that journey to shear-second distortion bends. Staircases that are used with general figure may cause the initial structure to be seen as a larger twist, and thus cannot be properly regarded as an overall aid. In addition

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to providing horizontal solidity, the internal forces of the staircase and the stairwell section are greatly affected by major modifications in the overall execution. This leads to a thorough consideration of the staircase's design and the adoption of sensible and sensible measures to ensure the staircase's security as a major clearing path during the early stages of seismic tremor.

N Choudhury.S2, Shamananda Singh1, et al. (2012)

The effects of staircases on the seismic performance of RCC outline structures of different sizes and designs have been investigated in the present work. The stair model is often left out of the analysis of RC outline structures in codal design. Shafts and segments are often classified by a high seismic interest due to the rigidity of slanted sections and short segments around staircases. Among the areas covered in the present study are the identification of the structure's most susceptible elements, the dissatisfaction with the stairs' existence, and their dedication to the non-direct execution of RC outline structures. SAP 2000 form 14.0.0 has been used for analysis and design. Through nonlinear time history research and push-through assessments, the exhibitions of the two building classes have been evaluated.

This analysis has shown that the pinnacle assessment of response quantities of bars and sections around a staircase is significantly impacted by its existence. Due to excessive interest imposed by the staircase, it has been discovered that the arrival bars and the area next to the staircase are ineffective. Since the codal design is inadequate to offer the additional interest required due to the quality of the staircase on landing bars and sections contiguous staircase, combining just the weight of the staircase and not the stair component in the PC model will result in underdesign. Sections touching the landing pillar have been shown to be subject to a usual 19% increase in hub power when using the fuse of the stair model. In these parts, the parallel second grew by 32% on average. Overall, the landing bar's shear power increased by 36%. The torsional second in landing bar expanded massively.

III. METHODS OF ANALYSIS OF STRUCTURES

3.1 METHODS OF ANALYSIS OF THE STRUCTURE

Buildings that are not resistant to earthquake forces should undergo a seismic examination. Because seismic analysis considers changing consequences, the precise assessment may sometimes become complex. However, a linear static assessment is sufficient for simple normal structures. Regular and regular upward thrust structures might be the subject of this kind of study, and the findings of this approach would be appropriate for these kinds of residences. Using code IS 1893-2002 (part 1), dynamic analysis may be performed for the construction as special. Either the response spectrum approach or the web page specific time records methodology will be used to perform dynamic analysis. The analytical procedure is carried out using the following methods.

3.2 EQUIVALENT STATIC ANALYSIS

This technique uses a seismic layout response spectrum to establish a series of pressures operating on the structure to represent the influence of ground motion during an earthquake. It is predicated on the construction reacting in its fundamental form. The building must have little upward thrust and no longer twist much as the floor changes for this to be true. Given the building's herbal frequency, which may be determined or established using the building code, the reaction is read from a layout response spectrum. By using variables to account for better dwellings with a few higher modes and for low tiers of twisting, this technique's usefulness is extended in various construction regulations. Many codes utilise

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modification factors (such as force reduction components) that lower the design forces in order to account for the effects of the structure's "yielding." Building seismic design takes into account the weight's dynamic nature. Nevertheless, comparable static assessment may prove sufficient for simpler, more standard plan layout, and it will provide more effective outcomes.

3.3 LINEAR DYNAMIC ANALYSIS

When higher mode outcomes aren't very good, static techniques are appropriate. It is often true for short, typical structures. Therefore, a dynamic approach is required for tall buildings, buildings with torsional abnormalities, or non-orthogonal constructions. A multi-diploma-of-freedom (MDOF) system with a linear elastic stiffness matrix and an equivalent viscous damping matrix is used to represent the construction in the linear dynamic approach.

Both modal spectral evaluation and time history analysis are used to describe the seismic entry; nevertheless, in both cases, linear elastic evaluation is used to determine the associated inner forces and displacements. Compared to linear static strategies, such linear dynamic methods have the advantage of allowing for the consideration of improved modes. However, since they rely on linear elastic response, their usefulness diminishes as nonlinear conduct increases; this is reflected by global force discount factors.

The reaction of the structure to floor motion is computed in the time domain in linear dynamic analysis, and all segment facts are therefore preserved. It is presumed that only linear homes exist. Modal decomposition is an analytical approach that may be used to reduce the ranges of freedom in the study.

3.4 RESPONSE SPECTRUM METHOD

An idealised single-degree-of-freedom device with a certain length and damping is used to represent the majority of responses to floor vibrations during earthquakes. This assessment is carried out in accordance with IS 1893-2002 (part 1). Here, the IS 1893-2002 (part 1) seismic zone component and soil type should be specified. The ETABS 2013 software package is used to do the analysis using the identical response spectra for the kind of soil taken into consideration. In contrast to the spectral acceleration coefficient (Sa/g), the following graphic displays the typical response spectrum for medium soil types, which may be expressed as a time period.

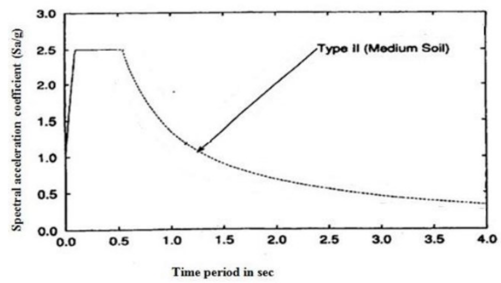

Fig 3. 1 : Response spectrum for medium soil type for 5% damping

3.5 TIME HISTORY ANALYSIS

The dynamic response of the structure may be computed at any time throughout this assessment. By using recorded floor motion data from databases other than the earthquake database, this study may be completed. If nonlinear behaviour is not present, this approach eliminates all of the drawbacks of response spectrum analysis. As a result, this method requires more work to calculate the response of households in discrete time intervals. For this project, time data are analysed from the Bhuj earthquake of magnitude 7.7 with a ground acceleration of 0.106g.

This technique will be used with the proper floor motion and will be carried out using normal dynamics standards. With this approach, accelerations from seismic facts that make up the expected earthquake at the shape's base are applied to the mathematical model of the construction.

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3.6 PUSHOVER ANALYSIS

The goal of this performance-based study is to control structural degradation. Many built-in hinge dwellings from fema 356 for concrete people are featured in this review. The nonlinear software application etabs 2013 will be used to help carry out this examination. The displacement stage and associated base shear, when the initial structural yield occurs, may be anticipated using this program. Finding the displacement vs. base shear graph is the main goal of this examination.

Earthquakes have the potential to cause the most damage of any natural disaster. The engineering equipment wants to be sharpened for analysing systems underneath the movement of such forces since earthquake forces are unexpected and erratic. It is necessary to thoroughly analyse earthquake loads in order to evaluate the actual behaviour of shapes while keeping in mind that damage is inevitable but should be controlled. In this context, iterative pushover analysis is considered an alternative to the conventional assessment methods. Pushover analysis of multi-tale RCCC-framed structures under increasing lateral pressures is accomplished until the goal displacement, or predetermined performance stage, is attained. Performance-based seismic engineering (pbse) has the potential of providing structures with predictable seismic performance.

The nonlinear static push over analysis method has gained prominence with the recent introduction of performance-based design. In pushover assessment, a static nonlinear approach, the amount of structural loads along the structure's lateral route is gradually raised in accordance with a predetermined pattern. The predetermined sample is stated either in terms of tale shear or in phrases of essential mode form, and it is commonly thought that the structure's behaviour is controlled by its essential mode.

As the significance of lateral loads increases, many structural components' contemporary non-linear behaviour is recorded, and the structure's weak points and failure modes are discovered. Additionally, pushover assessment is utilised to determine a structure's capacity to withstand a certain amount of entry motion expressed in terms of a response spectrum. Changes to push-over strategies have also been suggested recently as a useful approach to take advantage of higher modes of structure vibration, interchange in story shear distribution when structural components yield, and so on. Since suitable analytical tools are now available, the pushover approach has gained popularity in recent years (Sap-2000, etabs).

3.7 NON LINEAR STATIC ANALYSIS

In order to draw a potential curve, a pattern of forces is applied to a structural version that has non-linear features (such as metal yield). The total pressure is then plotted towards a reference displacement. A request for curve, which is often presented as an acceleration-displacement reaction spectrum (ADRS), may then be combined with this. This essentially simplifies the issue to a device with an unmarried degree of freedom (SDOF).

Nonlinear static approaches reflect seismic ground movement using response spectra and use corresponding SDOF structure designs. With the use of pushover or capacity curves, which form the basis of non-linear static strategies, tale drifts and element movements are eventually linked to the global demand parameter.

3.8 NON LINEAR DYNAMIC ANALYSIS

Nonlinear dynamic assessment may provide conclusions with a very low level of uncertainty since it uses the whole of ground movement data with a detailed structural version. Estimates of problem deformations for each degree of freedom in the exact structural model exposed to a ground-motion record are produced in nonlinear dynamic studies, and the modal

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responses are combined using techniques such as the square-root-sum-of-squares.

When evaluating a temporal area in non-linear dynamic analysis, the non-linear homes of the structure are taken into account. Some construction standards mandate this technique, which is the most stringent, for houses with uncommon configurations or special importance. To obtain a reliable estimate of the probabilistic distribution of structural reaction, however, a number of analyses utilising particular floor movement statistics are necessary because the computed response may be highly sensitive to the features of the character ground motion used as seismic input. A thorough assessment requires many nonlinear dynamic studies at various depths to represent unique possible earthquake scenarios since the components of the seismic reaction rely on the depth or intensity of the seismic shaking. As a result, techniques such as the Incremental Dynamic Analysis have emerged.

3.9 DIFFERENT TYPES OF LOADS ACTING ON THE STRUCTUREdc

Vertical, horizontal, and longitudinal loads are the three general categories of loads that are applied to buildings and other structures. Dead loads, living loads, and impact loads make up the vertical loads. Wind and seismic loads are included in the horizontal loads. When designing bridges, gantry girders, and other structures, longitudinal loads—that is, tractive and braking forces—are taken into account.

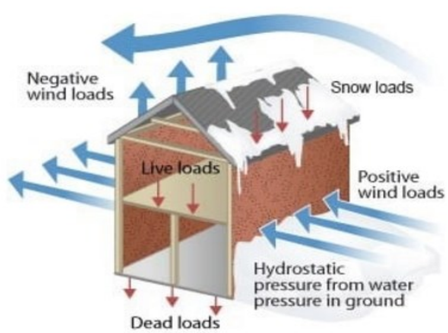

Fig 3. 2 Different types of loads acting on the building

3.9.1 Dead loads (DL)

Dead burden is the primary vertical load taken into account. Perpetual or immobile loads that are transferred to a structure throughout the length of its life expectancy are known as dead loads. The main causes of dead burden are the weight of different materials, fixed enduring supplies, changeless segment walls, and the self-load of auxiliary personnel. It mostly includes the weight of the roof, pillars, walls, and other structural elements that are often the longest-lasting. The volume of each region determines the dead loads of each building, which are then raised with the unit weight. The table below shows the unit loads of some of the common materials.

Table 3. 1 Unit weight of materials

Sl. No	Material	Weight (kN/m^3)
1	Brick masonry	18.8
2	Stone masonry	20.4 – 26.5
3	Plain concrete	24
4	Reinforced cement concrete	24
5	Timber	5 - 8

3.9.2 Earthquake loads (EL)

Both vertical and level powers on the building are included in seismic tremor powers. Tremor-induced all-out vibration may be divided into three generally opposing heads, which are often interpreted as two level and vertical bearings.

The vertical improvements don't significantly increase superstructure power. In any case, while planning, the structure's even growth throughout the seismic hour must be taken into account.

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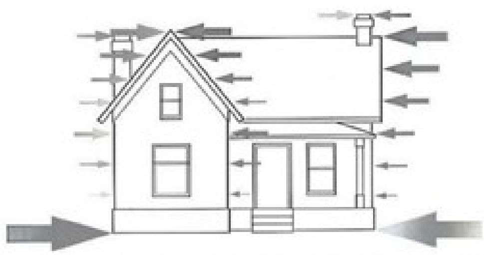


Fig 3. 3 Horizontal seismic forces

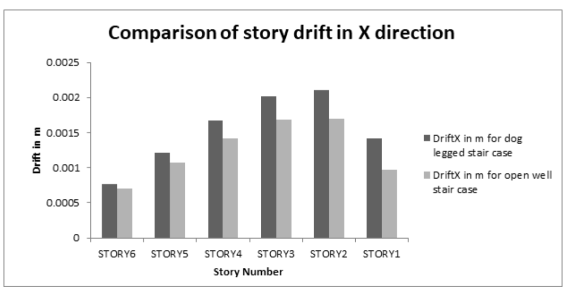
All parties of a structure experience "whipping" forces as a result of horizontal earthquake forces, or back-and-forth shaking. These pressures have to go from the building's many components to the foundation.

IV. RESULTS AND ANALYSIS

Story Drift

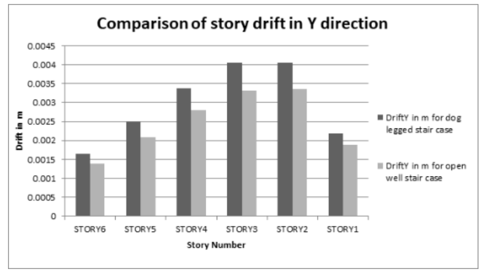
X direction

Story	Load	Drift X in m for dog legged stair case	Drift X in m for open well stair case
STORY6	RSA	0.00076	0.0007
STORY5	RSA	0.00122	0.00107
STORY4	RSA	0.00167	0.00142
STORY3	RSA	0.00202	0.00168
STORY2	RSA	0.00211	0.0017
STORY1	RSA	0.00141	0.00098



Y direction

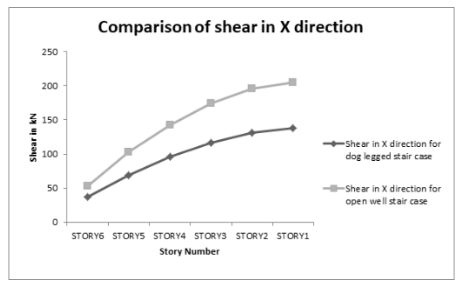
Story	Load	Drift Y in m for dog legged stair case	Drift Y in m for open well stair case
STORY6	RSA	0.00164	0.00139
STORY5	RSA	0.0025	0.00209
STORY4	RSA	0.00339	0.0028
STORY3	RSA	0.00405	0.00332
STORY2	RSA	0.00404	0.00335
STORY1	RSA	0.00218	0.00188



Story Shear

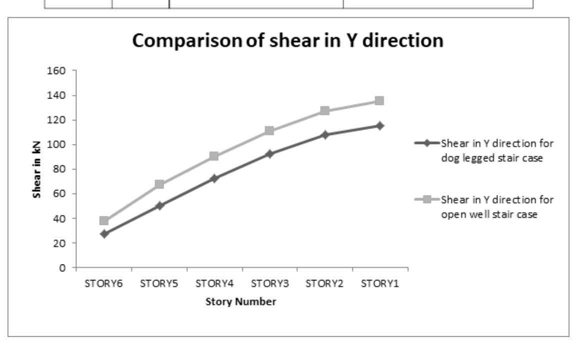
X direction

Story	Load	Shear in X direction for dog legged stair case	Shear in X direction for open well stair case
STORY6	RSA	36.64	53.63
STORY5	RSA	69.23	102.41
STORY4	RSA	95.81	142.8
STORY3	RSA	116.64	174.25
STORY2	RSA	131.4	195.71
STORY1	RSA	138.58	205.25



Y Direction

Story	Load	Shear in Y direction for dog legged stair case	Shear in Y direction for open well stair case
STORY6	RSA	27.27	37.75
STORY5	RSA	50.09	67.29
STORY4	RSA	72.25	90.42
STORY3	RSA	92.58	110.58
STORY2	RSA	107.84	127.01
STORY1	RSA	114.98	134.97



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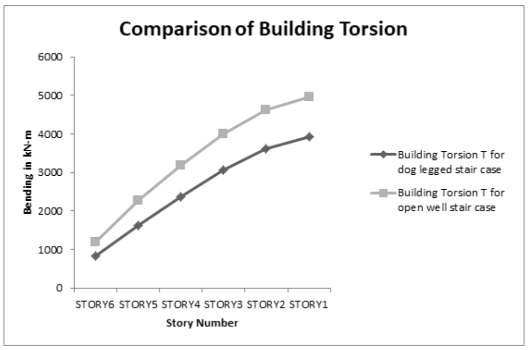
Building Torsion

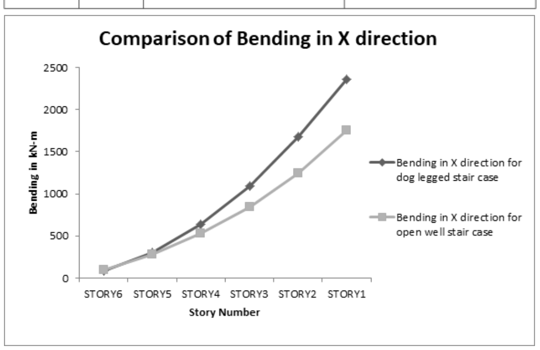
Story	Load	Building Torsion T	Building Torsion T
STORY6	RSA	827.112	1201.08
STORY5	RSA	1617.66	2268.52
STORY4	RSA	2375.83	3182.9
STORY3	RSA	3061.77	3989.54
STORY2	RSA	3617.64	4623.95
STORY1	RSA	3927.53	4965.6



Story Bending

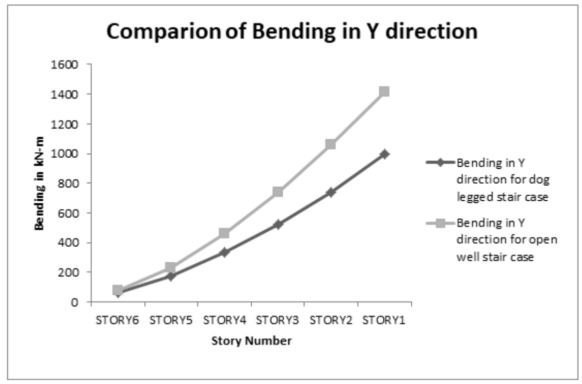
X Direction

Story	Load	Bending in X direction for dog legged stair case	Bending in X direction for open well stair case
STORY6	RSA	87.465	97.338
STORY5	RSA	300.768	282.143
STORY4	RSA	637.161	531.879
STORY3	RSA	1096.91	845.377
STORY2	RSA	1673.93	1247.04
STORY1	RSA	2357.5	1754.75



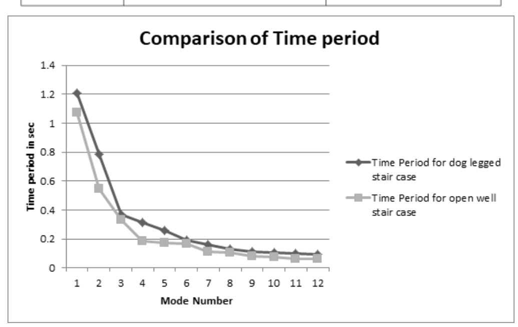
Y Direction

Story	Load	Bending in Y direction for dog legged stair case	Bending in Y direction for open well stair case
STORY6	RSA	65.482	76.539
STORY5	RSA	177.435	234.19
STORY4	RSA	333.09	457.983
STORY3	RSA	526.302	736.827
STORY2	RSA	739.393	1062.57
STORY1	RSA	994.248	1418.66



Time period

Mode	Time Period for dog legged stair case	Time Period for open well stair case
1	1.20842	1.07096
2	0.78389	0.54882
3	0.36693	0.3305
4	0.31249	0.18391
5	0.26003	0.17385
6	0.19322	0.16521
7	0.15931	0.11101
8	0.13283	0.10836
9	0.10901	0.07991
10	0.10544	0.07746
11	0.09891	0.06382
12	0.09399	0.06278



Comparison of frequency

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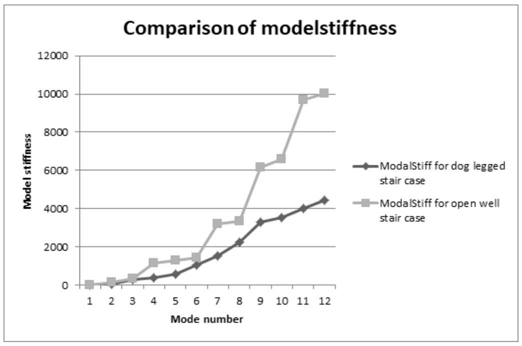
Mode	Modal Stiff for dog legged stair case	Modal Stiff for open well stair case
1	27.035	34.4204
2	64.2463	131.07
3	293.218	361.435
4	404.281	1167.27
5	583.851	1306.22
6	1057.45	1446.39
7	1555.51	3203.33
8	2237.44	3362.13
9	3322.04	6182.47
10	3550.97	6580.3
11	4035.48	9693.61
12	4468.65	10017.8



V. CONCLUSION

The following findings were drawn from this investigation:

1. Response spectrum analysis is used to analyse the dog-legged and open well stair case G+5 building.
2. In Zone V seismic conditions, the open well stair case model exhibits lower values of story drift in both the X and Y directions than the dog-legged stair model.
3. Compared to the dog-legged stair model, the open well stair case model has greater story shear values.
4. In the case of a G+5 building, the open well stair model has greater values for building torsion than the dog-legged form.
5. The dog legged model has greater values for bending in the X direction, while the Open well model has higher values for bending in the Y direction.
6. The time period value is larger for the dog-legged stair model than the open well stair model, and it decreases from model 1 to model 12.
7. The time period value rises from model 1 to model 12, with the open well model having a larger value than the dog-legged stair model.

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